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EFFECT OF ORAL ADMINISTRATION OF "GADAGI" TEA ON ACTIVITIES OF SOME ANTIOXIDANT ENZYMES IN RATS

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ABSTRACT
Effect of oral administration of *Gadagi* tea on some antioxidant enzymes was assessed in healthy male albino rats. The rats were grouped and administered with standard doses of the 3 types of *Gadagi* tea i.e. *Sak*, *Sada* and *Magani* for a period of four weeks. Animals that were not administered with the tea constituted the control group. At the end of fourth week, the animals were sacrificed and their serum superoxide dismutase (SOD), glutathione reductase (GR) and catalase (CAT) activities were determined. The activities of the enzymes were also determined in the brain, liver, kidney and intestine homogenates of the rats. Mean SOD activity in brain of rats orally administered with "sada" was found to be significantly higher ($P<0.05$) than that of the control group. Mean CAT activity in the intestine of rats orally administered with "magani" was found to be significantly higher ($P<0.05$) than that of the control group and the experimental groups of *Sak* and *Sada at standard dose level*. Thus, all the "Gadagi" tea preparations studied at standard dose level could stimulate antioxidant enzymes, especially SOD in brain and CAT in intestine (by *Sada*) and CAT in intestine (by *Magani*).

Keywords: Catalase, "Gadagi" tea, Glutathione reductase, Superoxide dismutase.

I NTRODUCTION

Gadagi tea is a composite used as a stimulant mostly by drivers and commercial motorcyclists in Kano and some parts of Northern Nigeria. The composition of 3 most common types of the tea i.e *Sak*, *Sada* and *Magani* has been published previously (Gadanya *et al*., 2011a). Those who take it believe that it can increase their power of endurance to pursue long lasting mental or physical work without fatigue (Gadanya, 20011).

Endurance is defined as the ability to sustain a specific activity for a long time. Short term endurance activities are associated with high levels of arousal and use of white muscle fibres that can contract very quickly. The energy released depends mainly on anaerobic respiration. Medium term endurance uses combination of muscle fibre types, some of which can contract slowly and others quickly. The energy for these comes from both anaerobic and aerobic respiration. Long – term endurance mainly use red muscle fibres that contract slowly and respire aerobically (Birben *et al*., 2012). Endurance events have experienced a significant increase in growth in the new millennium and are popular activities for participation globally (Vitale and Getzin, 2019).

Although oxygen is very essential for existence, it is a highly reactive molecule and can be a source of reactive intermediaries such as free radicals. Free radicals are molecules which contain unpaired electron in the outer orbitals, and is highly reactive in the body. The major source of reactive oxygen species are mitochondria, produced by electron transport chain in aerobic respiration as byproducts (Almokhtar *et al*., 2019). An imbalance between the production of ROS (i.e free radicals) and the ability of the antioxidant systems to readily detoxify these reactive intermediates results in oxidative stress (Katerji *et al*., 2019). Free radicals generated in excessive and uncontrollable amounts under oxidative stress conditions cause damage to DNA, proteins, and lipids, which can severely compromise cell health and contribute to disease development (McCord, 2000); Birben *et al*., 2012). In humans, oxidative stress is involved in many diseases such as atherosclerosis, heart failure, myocardial infarction and chronic fatigue syndrome.

Enormous stress, excessive exercise, sunlight radiation, cigarette smoke and every drug prescribed (which are common to "Gadagi" tea users) greatly increases the number of free radicals produced in the body thereby causing oxidative stress. However, there are antioxidant metabolites and enzymes, which prevent these reactive species from being formed, or, remove them before they cause damage. An increase in the activity of antioxidant enzyme systems including glutathione peroxidase, superoxide dismutase, catalase as well as glutathione transferase suggests a compensatory measure in response to oxidative stress (Alan and Cathy, 2001).

The aim of the study reported in this paper, was to determine the effect of oral administration of the 3 types of *Gadagi* tea on the activities of some antioxidant enzymes (CAT, SOD and GR) in the serum, brain, liver, kidney and intestine of rats

MATERIALS AND METHODS

Sample Collection and Preparation

Samples of "sak", "sada" and "magani" types of Gadagi" tea were obtained from Kofar Wambai Market, Kano, Nigeria (one of the oldest and the most popular "Gadagi" tea market). Methods of preparation of the 3 types of the tea was previously published (Gadanya *et al*., 2011a).

Dose Selection

The samples were subjected to direct heating process. Residues were obtained and weighed using a weighing balance. The procedure was repeated five times. Average amount of tea residues for a 70Kg were determined and used in the following formula to calculate the amounts of tea in cm^3 administered to the rats.

Formula:

$$\text{Amount of tea} = \frac{\text{Amount consumed by 70Kg man} \times \text{Average weight of rat (g)} \times \text{Dose (mg/Kg)}}{1000\text{g} \times \text{Amount of tea residue (mg)}}$$

where:

- Amount consumed by 70kg man = 700cm3
- Average weight of rats = 120g for "sak" and "magani" groups, and 100g for "sada" group.
- Average amount of tea residue = 53420mg, 60570mg, and 51350mg, for "sak", "sada" and "magani" respectively
- Dose (mg/kg) = 760mg/kg, 870mg/kg, and 730mg/kg, for "sak", "sada" and "magani" respectively.

Therefore, amount of tea in cm3 = 1.0cm3, 1.02cm3 and 0.995cm3 for "sak", "Sada" and "Magani" respectively.

Experimental Design

Twenty (20) healthy male albino rats were divided into four equal groups based on the type of "Gadagi" tea i.e. one control group and three experimental groups (for the three types of "Gadagi" tea).The experimental groups were orally administered with the tea at standard dose levels (i.e 760mg/kg, 830mg/kg and 730mg/kg for *Sak*, *Sada* and *Magani respectively*) using syringe once daily for a period of four weeks (the type of the tea administered was considered). At fourth week, all the rats were sacrificed. Blood samples, brain, liver, kidney and intestine were taken for analysis of superoxide dismutase, catalase and glutathione reductase activities in serum and homogenate.

Biochemical analysis and Statistical Analysis

Activities of superoxide dismutase, catalase and glutathione reductase in serum, brain, liver, kidneys and intestine were estimated using enzyme linked immunosorbent assay (ELISA) principle (R&D, 2010). Data collected were subjected to Analysis of variance (ANOVA) using the General Linear Model (SPSS for Windows).

RESULTS AND DISCUSSION

From the results of this study, mean SOD activity in brain of rats orally administered with *Sada* was found to be significantly higher ($P<0.05$) than that of the control group (Table I). Mean CAT activity in the intestine of rats orally administered with *Magani* was found to be significantly higher ($P<0.05$) than that of the control group and the remaining experimental groups i.e *Sak*, and *Sada* (Table III).

Cells are protected against oxidative stress by a network of antioxidant enzymes and metabolites that work together to prevent oxidative damage to the cells. In general, these systems and enzymes prevent the formation of reactive species or remove them before they cause damage. Activity of glutathione reductase is used as an indicator for oxidative stress (Smoth et al., 1988). An increase in the activity of anti oxidant enzymes including superoxide dismutase and catalase suggest a compensatory measure in response to oxidative stress (Alan and Cathy, 2001).Catalase has important cellular role because, hydrogen peroxide is a harmful byproduct of many normal metabolic processes. Thus, to prevent damage, it must be quickly converted into other less dangerous substances. Therefore, catalase is frequently used by cells to rapidly catalyse the decomposition of hydrogen peroxide into less reactive gaseous oxygen and water molecules (Gaetani *et al*., 1996).

Superoxide is one of the main oxygen species in cells which serves a key antioxidant role in nearly all cells exposed to oxygen (Li *et al.*, 1995). The increased activities of SOD and CAT observed could be associated with the phytochemicals present in the tea. A study has shown that, *Sada* and *Magani* contain alkaloids, tannins, flavanoids, glycosides and saponins (Gadanya *et al*; 2011b). The flavanoids have antioxidant properties towards a wide range of oxidizable substances (Obi, and Uneh, 2003).

CONCLUSION

All the "Gadagi" tea preparations studied at standard dose level could probably stimulate antioxidant enzymes in different tissues/organs of the body.

Table I: Serum, Brain, Liver, Kidney and Intestine Activity (U mg^{-1}) of Superoxide Dismutase (SOD) in Albino Rats Orally Administered with Standard Dose of *Sak*, *Sada* and *Magani* for Four (4) Weeks.

Group	Dose (mg/kg)	Serum SOD	Brain SOD	Liver SOD	Kidney SOD	Intestine SOD
Control	-	14.96 ±0.76	41.95 ±6.23[a]	29.30 ±4.63	45.53 ±14.00	32.26 ±3.30
Sak	760	14.50 ±1.45	41.74 ±3.85	28.91 ±16.75	43.88 ±14.21	22.22 ±2.96
Sada	870	13.75 ±2.79	53.70 ±6.59[a]	30.51 ±12.18	47.00 ±5.34	26.48 ±4.54
Magani	730	12.37 ±1.75	47.31 ±5.75	28.65 ±5.18	52.21 ±5.50	38.29 ±18.29

Results are presented as mean ± standard deviation. Values bearing similar superscript in the same column are significantly different ($P<0.05$).

Table II: Serum, Brain, Liver, Kidney and Intestine Activity ($\times 10^{-7}$ µmol min^{-1} mg^{-1}) Of Glutathione Reductase (GR) In Albino Rats Orally Administered With Standard Dose Of *Sak*, *Sada* and *Magani* For Four (4) Weeks.

Group	Dose (mg/kg)	Serum GR	Brain GR	Liver GR	Kidney GR	Intestine GR
Control	-	5.39 ±2.94	5.56 ±4.85	9.29 ±3.87	15.80 ±5.32	5.40 ±4.85
Sak	760	8.62 ±16.0	13.10 ±3.24	4.17 ±2.32	4.38 ±4.28	6.37 ±1.46
Sada	870	2.96 ±1.24	4.09 ±6.32	3.07 ±6.10	6.13 ±15.90	2.95 ±3.41
Magani	730	2.82 ±3.37	5.49 ±8.89	4.53 ±1.02	2.93 ±5.09	5.26 ±2.34

Results are presented as mean ± standard deviation. Values bearing similar superscript in the same column are significantly different ($P<0.05$).

Table III : Serum, Brain, Liver, Kidney And Intestine Activity ($\times 10^{-6}$ µmol min^{-1} mg^{-1}) Of Catalase (CAT) In Albino Rats Orally Administered With Standard Dose Of *Sak*, *Sada* And *Magani* For Four (4) Weeks.

Group	Dose (mg/kg)	Serum CAT	Brain CAT	Liver CAT	Kidney CAT	Intestine CAT
Control	-	0.61 ±0.28	23.90 ±7.80	3.72 ±1.33	2.75 ±0.57	1.07 ±0.86[a]
Sak	760	0.69 ±0.10	4.14 ±2.22	1.36 ±0.62	2.39 ±2.66	1.41 ±0.10[b]
Sada	870	21.10 ±51.5	16.90 ±29.60	2.33 ±2.50	3.23 ±2.33	1.70 ±0.86[c]
Magani	730	0.81 ±0.90	1.47 ±1.42	2.26 ±0.94	5.50 ±96.50	5.19 ±3.33[a,b,c]

Results are presented as mean ± standard deviation. Values bearing similar superscript in the same column are significantly different ($P<0.05$).

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